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CONN CENTER FOR RENEWABLE ENERGY RESEARCH

Conn Center Update & Planning

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http://www.conncenter.org

Update to Technical Advisory Board Meeting, Aug. 15, 2011

Mission Statement

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"Perform research and development on practical, economical, and potentially commercializable renewable energy and energy efficiency technologies and resources"

Defining Conn Center

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Defining R&D

- What are the grand energy challenges?
- What are the basic energy research needs?
- What are the transformational aspects?

Relationship to KY

Long Term Objective

Grand energy & environmental challenges

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- Low cost solar cells
- Non-food biomass sources for biofuels
- Large scale electrical energy storage
    - Intermittent energy sources
    - Grid stabilization
- Energy efficiency (60% of energy is wasted)
- Reduce carbon impact from coal & natural gas

Example scale of new economy: KY as an example

1. Electricity Energy demand: About 40% increase by 2025
7000 MW of additional electricity
1MW/22 jobs => 154,000 job-yrs –manufacturing/installation

2. Renewable fuels: Biomass resources of 25 M tons/yr
(by 2025)
About 10,000 – 14,000 rural jobs
Add new economy of $4 Billion dollars

3. Low energy costs: Manufacturing of renewables, assembly; batteries, electric cars; recycling; fuel cells

Conn Center Objectives

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- Long term strategy: A national center of excellence for renewable energy research
  - Energy device prototyping facilities
  - Research theme leaders
    (Build/maintain expertise)
- Engage students and faculty
  - co-ops; co-mentor/support PhD students
  - promote small group/center proposals
- Engage industry/enable startups
- Fulfill state mandate - CRERES

Core R&D Themes

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- Solar
- Biofuels
- Energy efficiency
- Energy Storage
- Advanced Energy Materials

Key Attributes

- Build/foster partnerships among all KY institutions
- Establish corporate partnerships

Conn Center – At a glance

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Core Personnel

Currently: 3 research leaders; 2 tech & admin staff
Expected: 8 research leaders; 4 tech & admin staff

Facilities – Lab space ~ 10,000 sq. ft

Unique facilities for energy device prototyping, testing; materials/fuels development & characterization

Communications

- Website – http://www.conncenter.org
- FaceBook, Press releases, E-news letter

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Highlights of Progress (2009-2011)

I. Personnel Hirings:

- Dr. Jacek Jasinski, Dr. Thad Druffel, Dr. Paul Ratnasamy (2 Yr term), Dr. Jagannadh Satyavolu
- Andrew Marsh, Budget Director
- Jeong H. Kim

II. "Special" Human Resource Structure:

- Research Scientist/Engineer (I thru IV)
- Associate Engineer (I thru IV)
- Annual vs Periodic Evaluation Procedures

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Highlights of Progress (2009-2011)

III. Facilities

- Lab scale energy device testing facilities
- Basic research facility: Ultrafast spectroscopy
- Large scale solar cell prototyping facilities
  (Glass plates & flexible substrates)

IV. Mentoring Junior Faculty in Energy Research

- Dr. Moises Carreon (Won CAREER award!)
- Dr. Delaina Amos
- Dr. Sam Park
- New hire in Chemistry for spectroscopy
- Dr. Matt Bohm, Dr. Sean Fu (Primary mentor – K. Walsh)

Highlights of Progress (2009-2011)

V. Involvement of Students/Faculty

- 20 Ph.D students
- 18 Undergraduate students (paid)
- High school students (~15)

- Faculty:

  Chem E (5); Mech E (3); ECE (3); Civil (2); Physics (1); Chemistry (2); Statistics (1)

- UK Faculty (4)

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Highlights of Progress (2009-2011)

VI. Development of small group proposals

~20 proposals in two years!

Goal -> One group grant per research theme

-> Five group grants => Center grant!

VII. Extramural Research Expenditures

2007 - $899,360

2008 - $874,792

2009 - $837,755

2010 - $1,144,264

2011 - $2,105,858

Goal: $5M/yr (2016)

Technology development efforts

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Advanced energy materials: scalable manufacturing processes for nanowires; graphene; ternary nitride

Solar: Low cost solar, graphene substrates; solar fuels

Biofuels: Oils to green diesel; jet fuel (catalyst route)

Energy storage: High capacity anodes/cathodes for Li-ion; ORR catalysts

Energy efficiency: Phase change materials, thermionic

Miscellaneous: Low velocity wind mill

Center Outreach Activities

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- KY statewide workshop: Renewable Energy and Energy Efficiency
- RE3 campus-wide student club
- Annual M.R. Wilhelm solar flight competition
- Solar decathlon proposal development effort
- Mentor undergraduate & high school students
- International research collaborations with Poland & Slovenia.

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Conn Center Team Proposals (2010-2011)

NSF –RENEWABLE STORAGE initiative (UofL, UK and Planar Energy) ($2M, 4 Yrs)

- A scalable storage system for solar/wind farms

  (Invited for Full Proposal; Declined for Funding)

DEDI – Kentucky Energy Commercialization Grants (4 projects) ($250K, 1 Yr), 2010-2011

- Technologies for commercialization of biofuels, natural gas, and carbon dioxide. (Awarded)

UofL – Clinical & Translational Science Pilot Grant Program (~$450K, 1 Yr), 2010-2012

(Awarded)

- A platform technology and reactor for bulk production of nanowires (NanowireX).
- High capacity and durable electrode materials for next generation Li ion batteries.

NSF – SBIR Phase I ($150K, 6 months) - $40K (UofL) (Awarded) (2011-2011)

- A method and reactor for continuous production of titania and related metal oxide nanowires.

NSF/DOE – Partnership on Thermoelectric Devices for Vehicle Applications (~$1M, 3 yrs)

- A tandem thermionic-thermoelectric device for automobile waste heat recovery. (DECLINED)

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Conn Center Team Proposals (2010-2011)

DOE –Marine and Hydrokinetic Technology Readiness Advancement Initiative ($160K,1 yr)

- Demonstration and optimization of a hydrokinetic device for enhanced energy conversion from low speed water currents. (DECLINED)

DOE - Biomass R&D Consortium Effort (UofL; UK; Sudchemie), $ 5M, 3 yrs, Preproposal – Declined.

"A regional consortium on value-added products from cellulosic biomass"

- DOE and USDA - Biomass R&D Consortium Effort (UofL; Brown Foreman; Sudchemie), $ 4M, 3 yrs, Preproposal – Pending.

"C5 rich stream from spent distillers grain"

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Conn Center Team Proposals (2010-2011)

DOE – Congressionally Directed Project: "University of Louisville Research and Energy Independence Program", $2M, July 1, 2010-June 30, 2012. (Awarded)

DOE - EPSCoR – Renewal of an implementation effort (UofL and UK), $2M, 3 yrs, 2011-2014 (Awarded)
"Nanoscale materials and architectures for energy conversion"

NSF Scalable Nanomanufacturing Initiative, (UofL), $2M, 2011-2015, (Recommended for funding but declined – fund if possible; second priority)
"SNM: Roll to roll manufacturing of nanowire arrays for energy applications"

NSF CHE-DMS-DMR SOLAR Initiative (UofL; UK; Iowa State)
"SOLAR: New Materials Search for Solar Energy Conversion to Fuels", $1.485M, 2011-2014 (Award being processed)

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Conn Center Team Proposals (2010-2011)

DOE-EERE, Transformational PV (UofL, Purdue, UT Arlington), $1.5M, 2011-2014 (Pending)

"Next Generation Scalable and Low-Cost Photovoltaic Manufacturing Using Earth-Abundant, Non-Toxic, Highly Absorbent Materials"

DOE-EERE, Transformational PV (ORNL, UofL, United Solar), $250K (for UofL), $1.5M, 2011-2014 (Pending)

"High-Efficiency via Incorporation of Crystalline Si Nanorods in Amorphous Si-based Thin-film Solar Cells"

DOE-EERE – Fuel Cell Technologies (UofL; Case Western Reserve; Stanford; and NREL), $4M, 3 yrs, 2011-2014 (Pending)

"Catalysts & supports for PEM fuel cells"

DOE-EERE– Fuel Cell Technologies (NREL, UNF, UofL)

"Cathodes for Direct Methanol Fuel Cells", $1M, 2011-2013 (Pending)

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Conn Center Team Proposals (2010-2011)

DOE – Industrial Assessment Centers (UofL – Mech. E., KPPC; Conn Center), $ 1.8M, 2011-2014 (Pending)

DOE – EPSCoR 2nd Implementation Award (UK; UofL), UofL minor partner (Pending) – Lithium ion battery research.

Conn Center –Major Research Project Funding (Current)

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1. DOE-EPSCoR Implementation Grant:
   "Nanoscale materials and architectures for energy conversion"
   $1.95 M (DOE); $0.5M from KY; PIs (6 UofL; 4 UK); 2007-2011.
   $2 M (DOE) PIs (6 UofL; 3 UK); 2011-2014.

2. DOE-CDP Project: "U of L research and energy independence", **$2M**, 2010-2012.

3. Translational research funding from UofL:
   "Materials development and manufacturing", **$0.45M**; 2010-2012

4. KY Energy Cabinet (energy commercialization grant) - "Technologies for commercializing CO_2, biofuels, and natural gas" **$250K**; 2010-2011.

5. NSF CHE-DMS-DMR SOLAR Initiative (UofL; UK; Iowa State) "SOLAR: New Materials Search for Solar Energy Conversion to Fuels", $1.485M, 2011-2014 (Award being processed for **$1.1M**)

6. KY PSC (thru DOE) – ARRA Smart Grid Initiative, **$150K**, 2010-2012.

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Proposed Five Year Strategy (2011-2016)

Year	Personnel	Facilities
2012	• Budget Director • Senior Research Technologist • Solar PV/PEC Device Theme Leader • Energy Efficiency or Storage Theme Leader	• Complete R2R • Initiate "non-traditional" manufacturing for Li-Ion.
2013	• Energy Storage or Efficiency Theme Leader • Materials manufacturing theme leader	• Non-traditional Li-ion line • "Tech Business Incubator" • Pre-commercial Biofuels research facility • Pre-commercial testing
2014	• Associate Director – Industry	• Concentrated Solar Facility
2015	• Additional Theme Leader (TBD) (Coal-Renewables)??	• Low cost lighting R&D
2016	• Associate Director – Federally funded center such as EFRC/ERC/MRSEC etc	• Pilot lines?

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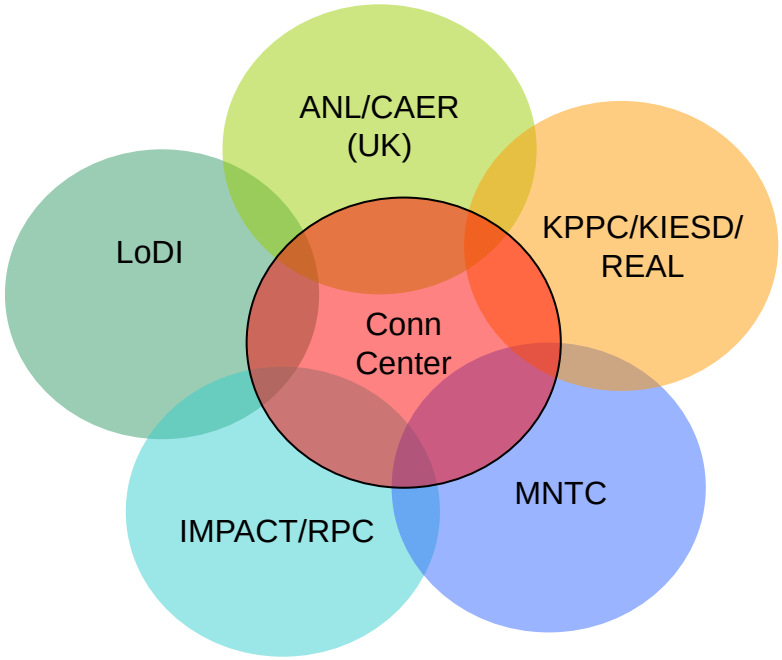

EXPECTED IMPACT for KY

- **Transportation Fuels/Sector**
  Electric & hybrid electric vehicles alternate fuels

- **Economic Impact**
  Translational R&D center to attract manufacturing sector to KY in the area of renewables.

- **Energy Efficient Buildings**
  Increase energy efficiency & use of renewable energy sources (ex: BIPV)

LEGEND

CCRER – Conn Center for Renewable Energy Research
KPPC – Kentucky Pollution Prevention Center
ANL – Argonne National Lab National Battery Research Center
LoDI – Logistics and Distribution Institute
RPC – Rapid Prototyping Center
MNTC – Micro/Nano Technology Center
IMPACT - Vehicle architecture research
REAL – Renewable Energy Applications Laboratory